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# A PRELIMINARY REPORT ON THE CONTROL OF THE GREEN PEACH APHID ON SHADE GROWN TOBACCO IN FLORIDA

By

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FLORIDA AGRICULTURAL EXPERIMENT STATIONS

In April 1947, *Myzus persicae* (Sulz.), commonly known as the green peach aphid, was found to be present in large numbers on shade grown tobacco in Gadsden County, Florida. The following is an account of the facts which are known concerning the outbreak and a report on the testing of a number of insecticides which will be available for use on the 1948 crop.

Chamberlin and Madden[2] have reported observing *Myzus persicae* (Sulz.) on tobacco in noneconomic numbers in a few instances during past years. In a conversation, Dr. R. R. Kincaid, Pathologist at the North Florida Experiment Station, recalled that growers had observed small infestations of aphids on tobacco at different times over the past fifteen years. They were probably never of any economic importance until 1946. During that season one grower in the western part of Gadsden County suffered almost a complete crop loss. At the same time there was considerable damage to some shades in the Madison area of Madison County. There were several other small infestations in the western part of Gadsden County, but they resulted in only minor damage.

Shade grown tobacco in Florida is characterized by an extremely high cost of production per acre. However, returns on

[1] Entomologists at the Central Florida Experiment Station, Sanford, Vegetable Crops Laboratory, Bradenton, Citrus Experiment Station, Lake Alfred and Florida Agricultural Experiment Station, Gainesville, respectively.

[2] Chamberlin, F. S., and Madden, A. H. Insect Pests of Cigar-type Tobaccos in the Southern Districts. U.S.D.A. Circular 639, p. 51, 1942.

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investment are excellent, and they justify the expense involved. It is estimated that by the time the tobacco has been transplanted to the shade, from 60 to 85 percent of the cost of producing the crop has been made. A 2 percent crop loss is considered to be a commercial one. During the 1947 season when aphid injury was severe, some shades were a total loss and the damage in others ranged from practically nothing to almost complete destruction. Aphid injury was characterized by a brown necrotic condition of heavily infested leaves. Honey dew, excreted by the aphids dropped on the foliage, and when leaves with honey dew were strung and dried, it was found that they stuck together, were dead and brittle, and would be unsatisfactory for market. Therefore, it is obvious that methods must be found for successfully combating this menace to the shade tobacco industry in Florida.

## HISTORY OF INFESTATIONS

Although the green peach aphid has been present in Florida for many years, it was first recorded as breeding on tobacco by A. N. Tissot in 1943.[3] It has a wide variety of host plants in Florida and has been collected from at least 70 different plants. At present, there is no evidence to point to any particular plant or crop as the source of the infestations which occurred in the tobacco fields.

In 1946, the known aphid infestations were located in the western part of Gadsden County and some were also reported from Madison County. In 1947, the first aphid infestation was reported to the North Florida Experiment Station on April 24 and it was located in western Gadsden County. Shortly thereafter other reports followed and a few came from the central and eastern parts of the County. In general, although the tobacco acreage is similar in the eastern and western parts of the County, more and heavier infestations existed in the western part, which was the same section in which the severe 1946 infestations occurred. By July 1947, all shades in the County were believed to contain aphids.

It has been impossible to determine satisfactorily the sources of the infestations in the shade grown fields. Two alternatives exist: either the aphids were introduced on plants at the time of transplanting, or winged aphids entered through the shade

[3] Unpublished record based on slides in the collection of the Entomology Department, Florida Agricultural Experiment Station.

cloth. There is some evidence to substantiate both contentions. In some instances several shades were planted from a single plant bed and all had aphid infestations. In one case, aphids were found in a plant bed from which a shade had been set about 2 weeks previously. At that time there were heavy aphid populations in part of the plant bed. An examination of the shade showed numerous plants with infestations consisting of 10-30 aphids. This appeared to be a definite instance where aphids were carried into the shade with the plants.

One shade in which the aphids were first noted about July 1, was a semi-isolated one near Scotland. On that date infested spots were found in the shade and all were marginal. The size of the colonies indicated that they were of less than a month's standing. In this case, therefore, it appeared that the infestation was initiated by winged aphids which entered through the shade. In many shades infestations were marginal and in others they were scattered through the shades. Since aphids could enter through the top as well as the sides of the shade, no definite conclusions could be drawn. Shades free from aphids could easily have aphids introduced by workmen coming from infested shades. In general it appeared that shades were infested by both methods and both must be considered in planning a control program.

Within the shades the aphid infestations followed a regular pattern. When an infestation was first found, it usually included only a local area comprised of several adjacent stalks in one row and an occasional plant in an adjacent row. The size of the infestations grew in the same pattern, with most of the spread lengthwise along the rows. This was probably accounted for by the fact that aphids could easily move from one plant to another in a given row. In addition, laborers in the shade working along the rows would tend to scatter aphids to other parts of the shade and even to other shades. It was noted that the aphid populations on young, new leaves consisted almost entirely of wingless forms, whereas there were many winged individuals on older, more mature leaves. Thus, as the leaves mature, more of the aphids grow wings and fly to other parts of the shade. This factor explains why spot dusting as practiced by some growers was often unsuccessful. By the time an infestation was found it had already served as a starting point for several new infestations. Even if all the aphids in it were killed, many other spots within the shade were already infested.

At that time only good, over-all treatment could have prevented general infestation.

Control methods in 1947 ranged from no treatment at all to a systematic application of certain materials. Since the growers were alarmed and often frantic, many control methods were used that were not at all practical. Some of the new chlorine compounds such as chlordane and benzene hexachloride were used with varying results. Most of the materials were compounded with tobacco dust which varied considerably in quality. Some of it was damp and lumpy. Tobacco dust was generally used as a diluent because the growers felt that it deposited less undesirable residue than other diluents. Normally, a thoroughly dry tobacco powder would remain usable throughout the year, but if the container was left open, or if it was exposed to the elements it would draw dampness and would not make a good dusting diluent.

Another material widely used was 1 percent and 2 percent rotenone in tobacco dust. This mixture was primarily used for the control of flea beetles. Three percent and 4 percent nicotine dusts were used extensively. A few growers used liquid nicotine sulfate and hexaethyl tetraphosphate for spot spraying, with generally erratic results.

As stated previously, the effectiveness of these applications varied with the operation. Chlordane at first gave an excellent kill, but later applications (perhaps of a different compounding) did not prove effective. Regular and thorough applications with rotenone gave a fair degree of control. Benzene hexachloride (1.5 percent gamma isomer) was perhaps as effective as any. However, on young plants a temporary chlorosis sometimes developed. Wherever any material piled up on a leaf a distortion of the leaf resulted from which it apparently never recovered.

## APHICIDE TESTS

Experiments to determine the efficacy of a number of different aphicides were initiated on July 4, 1947, and were continued through July and August. They were preliminary in nature, but will serve as a guide to materials which are promising for aphid control on shade grown tobacco.

METHODS.—Early experiments were performed on a small scale on only a few heavily infested plants for each treatment. All materials were applied as dusts with a hand duster. Aphid

counts were made by taking samples from each of five treated plants. The plants were sampled by cutting a disk from the same area of a leaf on each plant. The disks were two inches in diameter and were cut from the tobacco leaf with a cookie cutter. Each leaf disk was placed in a separate petri dish which bore an appropriate number for purposes of identification. The petri dishes containing the tobacco leaf disks were taken to the laboratory where the aphids were counted.

In the later tests conducted in growers' shades, heavily infested plants in each plot were marked with red tags before the aphicides were applied. Samples for determining the effectiveness of the materials were taken from these plants. It was necessary to use this method of marking infested plants because even in heavily infested shades the infestations were spotted. If a purely random method of sampling had been used a very large number of samples would have been required in order to obtain a representative sample of the aphid population. The dust materials were applied with a Root hand duster operated by an experienced laborer who did not know the meaning of the marks used. Thus the marked plants received as nearly as possible the same treatment as the remainder of the plants in the plot.

In the experiment conducted on the seed beds, a procedure developed by Dr. R. R. Kincaid in his blue mold investigations was used. The plots were 3 x 5 feet in area. An 8-inch board was set up at the boundary of each plot. The dust materials were applied under a rectangular tent constructed to fit over the plots, with a small plunger type dust gun manufactured by H. D. Hudson Manufacturing Company. By this method measured quantities could be applied without any drift to adjacent plots. Counts of aphids were made by plucking five leaves from each plot, a leaf from each corner and one from the center. These leaves were placed in numbered petri dishes and taken into the laboratory where the aphids were counted. The plots were arranged according to a random design and replicated three times.

TEST AT THE NORTH FLORIDA EXPERIMENT STATION.—Insecticides for this test were applied on July 4 in a shade grown by R. R. Kincaid for seed production. Results of this test based on aphid counts made 24 hours, 72 hours, 8 days, and 14 days after application of the materials are presented in Table 1. Two weeks after treatment the aphid populations in plots treated with 20 percent and 10 percent toxaphene, benzene hexachloride

TABLE 1.—NUMBER OF APHIDS PRESENT ON PLOTS TREATED WITH VARIOUS APHICIDES AT THE END OF 24 HOURS, 72 HOURS, 8 DAYS AND 14 DAYS AFTER TREATMENT.

| Treatment | Number of Aphids on 5 Leaf Samples After Treatment | | | |
|---|---|---|---|---|
| | 24 Hours | 72 Hours | 8 Days | 14 Days |
| Methoxy DDT 3% (in pyrophyllite) | 160 | 30 | 67 | 73 |
| Toxaphene [1] 20% (in pyrophyllite) | 45 | 5 | 9 | 13 |
| Toxaphene 10% (in pyrophyllite) | 81 | 6 | 17 | 25 |
| T 65 [2] | 24 | 9 | 44 | 108 |
| T 66 [3] | 18 | 25 | 86 | 172 |
| BHC [4], 1.5% gamma isomer (in pyrophyllite) | 4 | 1 | 7 | 25 |
| Isotox [5], 1.5% gamma isomer (in pyrophyllite) | 43 | 8 | 47 | 160 |
| Chlordane [6] 5% (in pyrophyllite) | 100 | 33 | 48 | 39 |
| Fixed Nicotine 3% (in pyrophyllite) | 7 | 8 | 39 | 77 |
| Activated Nicotine 4% | 0 | 3 | 98 | 81 |
| Rotenone 1% (in tobacco dust) | 65 | 13 | 10 | 26 |
| Rotenone 2% (in pyrophyllite) | 109 | 10 | 6 | 3 |
| Check | 156 | 151 | 112 | 305 |
| Chlordane [6] 5% (in pyrophyllite) | 87 | 24 | 23 | 27 |
| Chlordane 5% (in tobacco dust) | 15 | 19 | 17 | 37 |

[1] A chlorinated camphene having the formula $C_{10}$ $H_{10}$ $Cl_8$.

[2] Contains 0.625% piperonyl cyclohexenone and 0.05% pyrethrins.

[3] Contains 0.625% piperonyl butoxide and 0.05% pyrethrins.

[4] Benzene hexachloride.

[5] Refined benzene hexachloride made from a high-gamma base and having less of the objectionable odor.

[6] The chlordane came from different sources.

(1.5 percent gamma isomer), 1 percent rotenone, 2 percent rotenone, and 5 percent chlordane were still low in comparison with the check plot and plots treated with other materials.

TESTS CONDUCTED IN MR. CHARLES THOMAS' SHADE.—On July 10 the materials listed in the first section of Table 2 were applied in Mr. Charles Thomas' shade. The dust materials were applied with a Root hand duster. The liquid materials were applied with an atomizing machine manufactured by the Hession Microsol Corporation and supplied by the Gulf Fertilizer Company.

For the application of liquid materials to shade grown tobacco this machine has a number of disadvantages: (1) The machine is too large to be used in mature tobacco. (2) The high speed fan used to break up the liquid into small particles draws numerous leaves against the guard screen, thus destroying too much tobacco. (3) The machine does not give a good coverage on mature tobacco. Since growers report that tobacco free of

TABLE 2.—SUMMARY OF DATA FROM TESTS CONDUCTED IN MR. CHARLES THOMAS' SHADE. MATERIALS APPLIED JULY 10, 14 AND 18, 1947.

| Material and Concentration | Date of Application | Total Number of Aphids on 5 Leaf Samples After Treatment | | |
|---|---|---|---|---|
| | | 48 Hours | 72 Hours | 8 Days |
| Chlordane, 5% dust | July 10 | 14 | 11 | —[6] |
| 3422[1] 1% dust | | 0 | 0 | 1 |
| Nicotine Sulphate 1-400 | | 47 | 52 | — |
| Chlordane emulsion 40 oz.—100 gal. | | 46 | 99 | — |
| Chlordane emulsion 80 oz.—100 gal. | | 52 | 40 | — |
| Nicotine Sulphate 1-800 | | 49 | 60 | — |
| Check | | 121 | 147 | 345 |
| Check | July 14 | 82 | 49 | |
| HETP[2] 1-1600 | | 164 | 65 | |
| HETP 1-800 | | 4 | 10 | |
| TEP[3] 1-3200 | | 70 | 19 | |
| TEP 1-1600 | | 11 | 6 | |
| TEP 1-800 | | 3 | 9 | |
| Dusts: | July 18 | | | |
| Toxaphene 10% | | 18 | 0 | |
| Toxaphene 5% | | 15 | 2 | |
| BHC[4] 1.5% gamma | | 0 | 0 | |
| Isotox[5] 1.5% gamma isomer | | 17 | 5 | |
| Chlordane 10% | | 138 | 65 | |
| Fixed Nicotine 4% | | 86 | 93 | |
| 3422 1% | | 5 | 3 | |
| Check | | 99 | 167 | |

[1] O, o-diethyl o-p-nitrophenyl thiophosphate. 3422 is known now as Parathion.

[2] Hexaethyl tetraphosphate.

[3] Tetraethyl pyrophosphate.

[4] Benzene hexachloride.

[5] Trade name for refined BHC. Dust made up from material originally containing 85% gamma isomer.

[6] No counts were made in plots where figures are not given as casual observations showed high aphid populations in all of them. No counts were made at 8 days in plots treated July 14 and 18.

aphids to within 3 to 4 weeks of maturity suffered serious damage as a result of aphid attack after the plants were almost mature, a machine designed for use in shade grown tobacco must be capable of covering both the young and mature plants. (4) The machine requires large quantities of water to cover an acre. This requires frequent filling and increases the weight to be drawn by a mule.

A summary of the data gathered from these tests is presented in Table 2. Eight days after treatment there were practically no aphids on the plot treated with 3422 (O, o-diethyl o-p-nitro-

phenyl thiophosphate). The comparatively poor results obtained with the liquid sprays of HETP and TEP were believed to be due to poor coverage. Counts of aphids could not be made after July 20 because the tobacco in the treated plots was harvested on that date.

TESTS CONDUCTED IN MR. EDMOND CORRY'S SHADE.—These tests were performed in a shade of late planted tobacco. The owner, Mr. Edmond Corry, set aside approximately a half acre for the experiment. The data gathered from the tests conducted in Mr. Corry's shade are summarized in Table 3. On August 4 a heavy rain began falling immediately after the application of the materials was completed. Still an excellent control of aphids was obtained in the plot treated with 3422 where only 14 pounds per acre was applied.

TABLE 3.—SUMMARY OF DATA FROM THREE APPLICATIONS OF APHICIDES APPLIED TO THE SAME PLOTS IN EDMOND CORRY'S SHADE JULY 21, 29 AND AUGUST 4, 1947.

| Material and Concentration | Pounds Applied per Acre | | Total Number of Aphids | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | July 21 | | July 29 | | August 4 | |
| | July 29 | Aug. 4 | 48* Hrs. | 72* Hrs. | 48* Hrs. | 72* Hrs. | 48* Hrs. | 9* Days |
| Check | | | 219 | 224 | 102 | 241 | 171 | 86 |
| Toxaphene 10% | 28 | 21 | 50 | 29 | 54 | 61 | 103 | 43 |
| Toxaphene 5% | 17.5 | 31.5 | 99 | 55 | 66 | 75 | 69 | 38 |
| BHC[1] 1.5% gamma isomer | 21 | 28 | 97 | 68 | 16 | 28 | 27 | 56 |
| Isotox[2] 1.5% gamma isomer | 14 | 14 | 29 | 39 | 56 | 50 | 36 | 42 |
| Chlordane 5% | 31.5 | | | | 164 | 174 | **3 | 27 |
| Fixed Nicotine 4% | 14 | 17.5 | | | 74 | 115 | 145 | 81 |
| 3422[3] 1% | 14 | | 0 | 0 | 0 | 0 | ***5 | 3 |

In all of the above materials tobacco dust was used as a diluent except the dust containing Chlordane. Talc was used as a diluent in this mixture. Records of amounts of materials applied July 21 were not kept.

* After treatment.

** Treated with 1% 3422 at the rate of 14 pounds per acre.

*** Not treated.

[1] Benzene hexachloride.

[2] Refined BHC. Dust made from 85% gamma isomer.

[3] O, o-diethyl o-p-nitrophenyl thiophosphate.

SEED BED TREATMENTS.—A seed bed at the North Florida Experiment Station was made up and fertilized in accordance with the standard practices of the area. The seed were planted on July 5 and began coming up July 13. The plants grew very rapidly and were ready for transplanting August 6. The bed

was dusted on July 28 at the rate of 20 pounds per acre with 5 percent DDT for flea beetle control and on August 6 with 50 percent arsenate of lead in tobacco dust for fall army worm control. Applications of 20 percent Fermate in talc, at the rate of 20 pounds per acre, were made to the whole seed bed area on the following dates: July 30, August 4, 6, 12, and 14. Aphids were introduced by placing heavily infested tobacco leaves in each plot on July 27, 30 and August 5. Applications of the aphicides were made at the rate of 33 pounds per acre on July 29, August 2 and 8. Check plots were treated with 20 percent fermate on these dates. Counts of aphids made July 31 and August 4, 48 hours after the first and second applications of the materials, indicated that the aphid population was too small for the data to be valid. For this reason only the counts made following the third application are given in Table 4. Table 5 presents the composition of the materials used. After three applications of these materials there was no indication of injury to the young seedlings. It will be noted from Table 4 that 3422, rotenone, Isotox, benzene hexachloride, and toxaphene, with and

TABLE 4.—SUMMARY OF THE DATA FROM COUNT MADE 24, 48 AND 72 HOURS AFTER APPLICATION OF VARIOUS MATERIALS FOR APHID CONTROL IN SEED BEDS. MATERIALS APPLIED AUGUST 8, 1947. FIGURES GIVEN ARE MEANS OF THREE APPLICATIONS.

| Treatment No. | Mean Number of Aphids at Intervals After Treatment | | | Materials |
|---|---|---|---|---|
| | 24 Hours | 48 Hours | 72 Hours | |
| 1 | 0 | 0 | 0.33 | 3422 1% and 20% Fermate |
| 2 | 1.50 | 0.66 | 0 | Rotenone 1.6% and 20% Fermate |
| 3 | 0.33 | 0 | 0 | Isotox 1.5% gamma isomer and 20% Fermate |
| 4 | 0 | 0 | 0 | BHC 1.5% gamma isomer and 20% Fermate |
| 5 | 0 | 1.33 | 0.33 | Toxaphene 10% and 20% Fermate |
| 6 | 4.33 | 6.33 | 10.33 | Fixed Nicotine 4% and 20% Fermate |
| 7 | 1.66 | 2.66 | 3.33 | Chlordane 5% and 20% Fermate |
| 16 | 3.00 | 4.33 | 4.00 | HETP 5% and 20% Fermate |
| 8 | 0 | 0 | 0 | 3422 1% |
| 9 | 0 | 0 | 1.66 | Rotenone 2% |
| 10 | 0.33 | 0 | 0 | Isotox 1.5% gamma isomer |
| 11 | 0.33 | 0 | 0 | BHC 1.5% gamma isomer |
| 12 | 0.66 | 0 | 0 | Toxaphene 10% |
| 13 | 13.33 | 7.66 | 4.66 | Fixed Nicotine 4% |
| 14 | 4.33 | 3.33 | 5.00 | Chlordane 5% |
| 15 | 13.33 | 16.33 | 9.66 | Check |
| 17 | 1.66 | 1.00 | 2.66 | HETP 5% |

For the 72-hour count differences between means required for significance at the 1% point are 6.1 and 5% point 4.5.

TABLE 5.—COMPOSITION OF THE VARIOUS MATERIALS USED FOR APHID CONTROL IN THE SEED BED AT THE NORTH FLORIDA EXPERIMENT STATION.

| Treatment No. | Active Ingredient Percent | Made Up from Concentrate Containing Percent | Source of Concentrate | Fermate Percent | Talc or Other[1] Inert Clay Percent |
|---|---|---|---|---|---|
| 1 | DNTP 0.8% | 1 | American Cyanamid Co. | 20 | 79.2[2] |
| 2 | Rotenone 1.6 | 2 | Unknown | 20 | 78.4[2] |
| 3 | Isotox 1.5% gamma isomer | 25 | Calif. Spray-Chem. Co. | 20 | 78.5 |
| 4 | BHC 1.5% gamma isomer | 6 | Calif. Spray-Chem. Co. | 20 | 78.5 |
| 5 | Toxaphene 10% | 40 | Hercules Powder Co. | 20 | 70.0 |
| 6 | Fixed Nicotine 4% | 14 | Tobacco By-Products Co. | 20 | 76.0 |
| 7 | Chlordane 5% | 50 | Dow Chemical Co. | 20 | 75.0 |
| 8 | 3422 1% | 1 | American Cyanamid Co. | — | 99.0 |
| 9 | Rotenone 2% | 2 | Unknown | — | 98.0[2] |
| 10 | Isotox 1.5% gamma isomer | 25 | Calif. Spray-Chem. Co. | — | 98.5 |
| 11 | BHC 1.5% gamma isomer | 6 | Calif. Spray-Chem. Co. | — | 98.5 |
| 12 | Toxaphene 10% | 40 | Hercules Powder Co. | — | 90.0 |
| 13 | Fixed Nicotine 4% | 14 | Tobacco By-Products Co. | — | 96.0 |
| 14 | Chlordane 5% | 40 | Dow Chemical Co. | — | 95.0 |
| 15 | Check | | | | |
| 16 | HETP 5% | Unknown | Walker Fertilizer Co. | 20 | 75.0[2] |
| 17 | HETP 5% | Unknown | Walker Fertilizer Co. | — | 95.0[2] |

[1] The diluent used in the concentrates is unknown. Attaclay or other inert clays are commonly used. Talc was used in all the mixtures prepared at the Experiment Station.

[2] Prepared by the Company furnishing the materials; diluent used unknown.

without 20 percent fermate, gave practically a complete control of the aphids. Although statistically there is no significant difference between the HETP dust and the other materials listed above, it is believed that the number of aphids found in the HETP plots is too high for seed beds. The HETP dust also has the serious disadvantage of being very unstable. This particular mixture of HETP was of very poor quality. It contained lumps and foreign material. Since these results were obtained under conditions prevailing in July and August, they may not be comparable to results obtained during the normal growing season.

## SUMMARY AND CONCLUSION

Although the green peach aphid had been observed on shade grown tobacco prior to 1946 it had never been of economic importance until that season.

During the 1946 crop season, crop losses resulting from the attack of the green peach aphid were reported from restricted localities in Gadsden and Madison Counties.

Severe damage resulting in an almost complete loss of the crop was experienced by a number of growers in the shade tobacco area during the 1947 season. Very few growers passed through the season without some aphid damage to their crop.

Investigation of methods of control of this aphid were initiated at the North Florida Experiment Station during June 1947. Results of experiments conducted in a shade grown for seed production and in two late planted commercial shades, show that a dust containing 1 percent O, o-diethyl o-p-nitrophenyl thiophosphate is superior to other materials used.

Data from the experiment conducted in the seed bed showed that dusts containing 1 percent 3422, 1.6 percent rotenone, 1.5 percent gamma isomer in both the crude and refined forms of benzene hexachloride and 10 percent toxaphene with and without 20 percent fermate gave excellent control of aphids without any injurious effect upon the plants.

## ACKNOWLEDGMENTS

The writers wish to express their appreciation to Mr. J. D. Warner, Vice-Director in Charge of the North Florida Experiment Station, Quincy, and to Dr. R. R. Kincaid and other members of the staff for their help and courteous cooperation in this work. To Mr. Ted Basset, Farm Superintendent at the North Florida Experiment Station, recognition is due for his untiring efforts and skill in the management of the seedbed. Mr. F. S. Chamberlin of the Bureau of Entomology and Plant Quarantine gave valuable and helpful suggestions and advice. Mr. A. G. Driggers, County Agent of Gadsden County, rendered helpful service in many ways. To Mr. Frank Holland of the Florida Agricultural Research Institute, credit should be given in expediting equipment and materials used in our tests. Mr. Leonard Vance of the Southern Chemical Sales and Service Company was always willing to help us secure material and meet growers. The authors are indebted to the Companies mentioned in Table 5 for supplying various insecticides. Finally, the growers cooperated in every way to help in this survey.

# A PRELIMINARY KEY TO THE WORKER ANTS OF ALACHUA COUNTY, FLORIDA [1]

By

ARNOLD F. VAN PELT

The following key is an outgrowth of a study on the ecology of the ants of the Gainesville region and vicinity in Alachua County, Florida. It is based, with modifications, on the work of Cole (1940), Creighton (1939), Gregg (1944), Smith (1936, 1942a, 1942b, 1943, 1944, 1947), and Wheeler (1910).

Certain groups, such as the subgenus *Diplorhoptrum* of the genus *Solenopsis,* contain more representatives from the region studied than the key indicates. These forms have not been included because of the uncertainty of their taxonomic status. They differ only slightly from other forms in the key. Under certain other genera forms are listed as "Species A" or "Species B". These are not to be considered new until further diagnoses can prove or disprove their correspondence with known species, subspecies, or varieties. The term "var." indicates that the specimens involved are atypical of the species or subspecies.

The record of *Iridomyrmex humilis* is included on the authority of Wheeler (1932), but Smith (in litt) states that he questions its validity.

The ant list for Alachua County as here presented cannot be considered complete, but it is felt that it will serve as a basis for future myrmecological work in Florida, if not in the most northern and southern districts, at least in the central district.

Thanks are due the members of the Department of Biology of the University of Florida for suggestions and aid. I am particularly indebted to Dr. M. R. Smith of the United States National Museum for aid in the determination of the more difficult forms and for his permission to redraw the figures appearing in his 1947 paper. The American Midland Naturalist has also kindly granted permission for the redrawing of Smith's figures. Miss Esther Coogle, of this department, has ably executed the drawings. In some cases the ants represented are not found in Alachua County, but these are included to show subgeneric characters.

[1] Contribution from the Department of Biology, University of Florida.

KEY TO THE SUBFAMILIES [2]

1. Abdominal pedicel composed of two segments, the petiole and postpetiole ..... 2

1'. Abdominal pedicel composed of a single segment, the petiole ..... 4

2(1). Frontal carinae located very close to each other and not covering the antennal insertions ..... 3

2'. Frontal carinae not placed close to each other and each often bearing a lobe which more or less conceals the antennal insertion; clypeus almost always prolonged back between the frontal carinae ..... MYRMICINAE

3(2). Eye remarkably large, reniform or subelliptical, occupying approximately half the length of the side of the head; ocelli usually present; clypeus not prolonged back between the frontal carinae PSEUDOMYRMINAE

3'. Eye either absent or vestigal, ocellus-like; no ocelli ..... DORYLINAE

4(1'). Cloacal orifice circular, terminal, surrounded by a fringe of hairs FORMICINAE

4'. Cloacal orifice not as described above ..... 5

5(4'). No constriction between the first and second gastric segments; integument usually soft, flexible; sting rudimentary or absent; anal glands present which produce a characteristic "tapinoma odor" DOLICHODERINAE

5'. A pronounced constriction between the first and second gastric segments PONERINAE

KEY TO THE DORYLINAE

1. Head distinctly shining, never densely sculptured or opaque ..... *Eciton opacithorax* Emery

1'. Head, thorax, petiole, and postpetiole densely punctate, opaque, with scattered foveolate impressions (Plate I, Fig. 1) ..... *Eciton nigrescens* (Cresson)

KEY TO THE PONERINAE

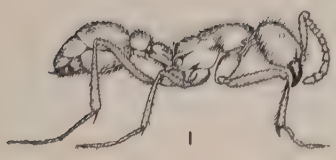
1. Mandibles inserted at the corners of the head; petiole rounded or flattened above ..... 2

[2] The subfamily Cerapachyinae is not represented in Alachua County.

PLATE I

Fig. 1. *Eciton (Neivamyrmex) nigrescens* (Cresson), worker.
Fig. 2. *Euponera (Trachymesopus) gilva* (Roger), worker.
Fig. 3. *Ponera coarctata pennsylvanica* Buckley, worker.
Fig. 4. *Leptogenys (Lobopelta) elongata* (Buckley), worker.
Fig. 5. *Aphaenogaster (Attomyrma) treatae* Forel, worker.
Fig. 6. *Cardiocondyla emeryi* Forel, worker.
Fig. 7. *Crematogaster (Orthocrema) minutissima missouriensis* Emery, worker.
Fig. 8. *Crematogaster (Acrocoelia) laeviuscula* var. *clara* Mayr, worker.
Fig. 9. *Monomorium (Monomorium) minimum* (Buckley), worker.
Fig. 10. *Xenomyrmex stolli floridanus* Emery, worker.
Fig. 11. *Solenopsis (Solenopsis) xyloni* McCook, soldier.
Fig. 12. *Solenopsis (Euopthalma) globularia littoralis* Creighton, worker.

PLATE I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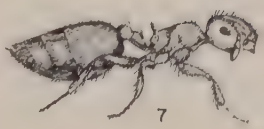
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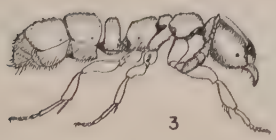
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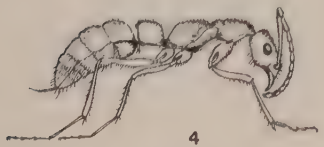
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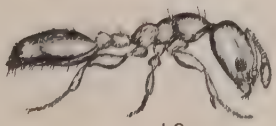
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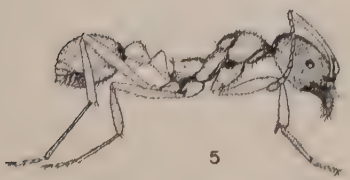
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1'. Mandibles inserted close together at the middle of the oral border; petiole terminating in a spine or point above ..... *Odontomachus haematoda insularis* Guerin

2(1). Claws pectinate (similar to Plate I, Fig. 4) ..... *Leptogenys elongata manni* Wheeler

2'. Claws simple ..... 3

3(2'). Tibiae of middle and hind legs each with a single spur....*Ponera* Latr.

3'. Tibiae of middle and hind legs each with 2 spurs, the smaller being sometimes difficult to discern (Plate I, Fig. 2) ..... *Euponera gilva* (Roger)

### KEY TO THE SPECIES OF *Ponera*

1. Petiole when viewed in lateral profile slender, sub-triangular (that is, narrower dorsally than ventrally) ..... *trigona* var. *opacior* Forel

1'. Petiole when viewed in lateral profie robust, sub-rectangular (that is, approximately as wide dorsally as ventrally) ..... 2

2(1'). Head with dense, coarse punctures, subopaque (Plate I, Fig. 3) .... *coarctata pennsylvanica* Buckley

2'. Head densely, but more finely punctate, thus giving the general surface a subopaque appearance but lacking the coarse granular effect .... *opaciceps* Mayr

### KEY TO THE PSEUDOMYRMINAE

1. Color red-brown to dark brown; about 4.0 mm. in body length ..... *Pseudomyrma brunnea* F. Smith

1'. Color light to dark yellow; about 5.0 mm. in body length ..... *Pseudomyrma flavidula* F. Smith

### KEY TO THE MYRMICINAE

1. Antennae with six segments ..... *Strumigenys louisiana* Roger

1'. Antennae with more than six segments ..... 2

---

### PLATE II

Fig. 13. *Solenopsis (Diplorhoptrum) pergandei* Forel, worker.
Fig. 14. *Leptothorax (Dichothorax)* sp., worker.
Fig. 15. *Trachymyrmex septentrionalis obscurior seminole* Wheeler, worker.
Fig. 16. *Dolichoderus (Hypoclinea) taschenbergi* Mayr, worker.
Fig. 17. *Dorymyrmex (Conomyrma) pyramicus flavopectus* M. R. Smith, worker.
Fig. 18. *Brachymyrmex (Brachymyrmex)* sp., worker.
Fig. 19. *Camponotus (Myrmothrix) abdominalis floridanus* (Buckley), major worker.
Fig. 20. *Camponotus (Myrmentoma) caryae nearcticus* Emery, major worker.
Fig. 21. *Camponotus (Colobopsis) etiolatus* Wheeler, soldier.
Fig. 22. *Paratrechina (Paratrechina) longicornis* (Latreille), worker.
Fig. 23. *Paratrechina (Nylanderia) parvula* (Mayr), worker.
Fig. 24. *Formica (Neoformica) pallidefulva schaufussi* Mayr, worker.

PLATE II

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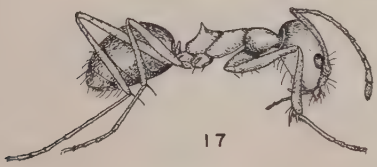
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2(1'). Antennae with ten segments, the last two segments of the funiculus forming a distinct club ..... *Solenopsis* Westwood

2'. Antennae with more than ten segments ..... 3

3(2'). Antennae with eleven segments ..... 4

3'. Antennae with twelve segments ..... 7

4(3). Postpetiole attached to dorsal surface of the base of the gaster; gaster subcordate, more convex ventrally than dorsally and with an acute apex ..... *Crematogaster* Lund

4'. Postpetiole attached to basal surface of gaster; gaster not as above .... 5

5(4'). Region between mandible and inner border of eye with a longitudinal carina which extends posteromesially (Plate II, Fig. 15) ..... *Trachymyrmex septentrionalis obscurior seminole* Wheeler

5'. Region between mandible and inner border of eye without a longitudinal carina ..... 6

6(5'). Epinotum unarmed; integument smooth or very weakly sculptured (Plate I, Fig. 10) ..... *Xenomyrmex stolli floridanus* Emery

6'. Epinotum armed; part of integument, at least, with well-developed sculpture ..... *Leptothorax bradleyi* Wheeler

7(3'). Clypeus elevated in the form of a carina or ridge in front of the antennal socket ..... *Tetramorium* Mayr

7'. Clypeus otherwise; if clypeus appears somewhat similar to that described above, then the spurs of each middle and hind tibia are pectinate, the mesoepinotal constriction on the dorsal surface of the thorax is usually absent or obsolescent, and the ventral surface of the head may bear a psammophore ..... 8

8(7'). Spurs of each middle and hind tibia very distinctly pectinate ..... *Pogonomyrmex badius* (Latr.)

8'. Spurs of each middle and hind tibia simple or absent ..... 9

9(8'). Epinotum unarmed ..... *Monomorium* Mayr

9'. Epinotum armed ..... 10

10(9'). In profile, clypeus strongly projecting above mandibles; each middle and hind tibia without spurs; body clothed with closely appressed pubescence; erect hairs almost, if not entirely, absent from the dorsal surface of the body except on the clypeus, mandibles, and apex of gaster; monomorphic; small (1.6-2.5 mm.) ..... *Cardiocondyla* Emery

10'. Differing in one or more characters ..... 11

11(10'). Antennae without a 3-segmented club ..... *Aphaenogaster* Emery

11'. Antennae with a 3-segmented club ..... 12

12(11'). Dimorphic (or polymorphic), the soldier with an abnormally large head ..... *Pheidole* Westwood

12'. Monomorphic form which lack the large-headed soldier (Similar to Plate II, Fig. 14) ..... *Leptothorax floridanus* Emery

KEY TO THE SPECIES OF *Aphaenogaster*

1. Base of antennal scape lobed or with an extension ..... 2

1'. Base of antennal scape not lobed ..... 3

2(1). Color yellow to yellow-brown; postpetiole elongated; well-developed, protruding lobe at base of antennal scape ..... *floridana* M. R. Smith

2'. Color ferruginous red to dark brown; postpetiole not elongated; more node-like ..... 5

3(1'). Body length under 4.0 mm. ..... *texana nana* Wheeler

3'. Body length 5.0 mm. or over ..... 4

4(3'). Dorsal portion of head rugulose-punctate, the rugulae being very low ..... *texana silvestrii* Menozzi

4'. Dorsal portion of the head rugulose punctate, the rugulae being prominent and running longitudinally ..... *lamellidens* Mayr

5(2'). Lobes at base of antennal scapes extending for a short distance up the scape; lobes convex away from carinae; dark brown in color (similar to Plate I, Fig. 5) ..... *treatae ashmeadi* Emery

5'. Lobes at base of antennal scape short, convex toward carinae; ferruginous red in color ..... *lamellidens* Mayr

### KEY TO THE SPECIES OF *Pheidole*

1. Epinotal spines vestigal, or very short and blunt in the worker ..... *morrisi* Forel

1'. Epinotal spines distinct ..... 2

2(1'). Color black, with a metallic appearance; gaster, occiput, and median longitudinal line on thorax shining ..... *metallescens* Emery

2'. Color other than black, metallic appearance lacking ..... 3

3(2'). Color dark brown or reddish brown; minor worker about 3.0 mm. in body length ..... 4

3'. Color yellow or very light brown ..... Species B, *cf. floridana* Emery

4(3). Size of major worker about six millimeters; major worker slender; epinotal spines short but distinct in minor worker, longer in major worker ..... Species A

4'. Size of major worker only slightly larger than that of minor worker, or about 4.0 mm. ..... 5

5(4'). Posterior half of head, not merely occiput, dorsum of the prothorax and mesothorax, and dorsum of the petiole and postpetiole smooth and shining ..... *commutata* Mayr

5'. Posterior half of head, etc., not as above ..... *dentata* Mayr

### KEY TO THE SPECIES OF *Cardiocondyla*

1. Petiolar node, from above, very distinctly longer than broad, compressed (Plate I, Fig. 6) ..... *emeryi* Forel

1'. Petiolar node, from above, not as described, more sub-globular and lacking the distinctly compressed appearance; gaster a deep uniform brown or black ..... *nuda* var. *minutier* Forel

### KEY TO THE SPECIES OF *Crematogaster*

1. Antennal club 3-segmented; postpetiole with an impression or longitudinal furrow dividing it into two more or less distinct lobes .... 2

1'. Antennal club 2-segmented; postpetiole without an impression or longitudinal furrow ..... 3

2(1). Epinotal spines about one-half as long as the distance that separates their bases and rather strongly directed upward; pronotum with the rugae usually lateral in position (Plate I, Fig. 7) ..... *minutissima missouriensis* Emery

2'. Epinotal spines less than half as long as the distance which separates their bases and directed more backward than upward; pronotum with two prominent rugae near middle ..... *minutissima minutissima* Mayr

3(1'). Thorax with reticulate-rugose sculpturing ..... *lineolata* (Say) var.

3'. Thorax smooth and shining, or only slightly sculptured ..... 4

4(3'). Epinotal spines robust and incurved; deep brown to blackish in color ..... *ashmeadi* Mayr

4'. Epinotal spines long; head and thorax brown, gaster black (similar to Plate I, Fig. 8) ..... *laeviuscula* Mayr

KEY TO THE SPECIES OF *Monomorium*

1. Clypeal teeth prominent; color brown or black ..... 2

1'. Clypeal teeth indistinct; color straw yellow to yellowish red ..... *pharaonis* (L.)

2(1). Antennal fossa with concentric rugulae; pronotum about twice as wide as dorsum of epinotum; color dark brown ..... Species A

2'. Antennal fossa without rugulae, shining; pronotum less than twice as large as epinotum; color very dark brown or black (Plate I, Fig. 9) ..... *minimum* (Buckley)

KEY TO THE SPECIES OF *Solenopsis*

1. Width of postpetiole from the dorsal aspect, twice as great as that of the petiole; monomorphic (Plate I, Fig. 12) ..... *globularis littoralis* Creighton

1'. Width of postpetiole from the dorsal aspect the same, or only slightly larger than that of the petiole ..... 2

2(1'). Body length 2 mm. or less; monomorphic ..... 4

2'. Body length of minor worker about 3 mm.; polymorphic, body length of major worker being more than 3 mm. ..... 3

3(2'). Head and rest of body dark brown, or head slightly tinged with reddish brown; mesosternum of the thorax without a spine or projection (similar to Plate I, Fig. 11) ..... *geminata* (F.)

3'. Head a light reddish yellow, with the abdominal segments narrowly bordered with brown; mesosternum of the thorax with a spine or projection (similar to Plate I, Fig. 11) ..... *geminata rufa* (Jerdon)

4(2). Postpetiole appearing subglobular from above (Plate II, Fig. 13) *pergandei* Forel

4'. Postpetiole not appearing subglobular from above ..... 5

5(4'). Head and gaster deep brown and usually darker than the thorax;

petiolar node not at all, or only slightly, extended laterally over the peduncle from dorsal view; from side view, node rounded above, about the same width above as below ..... *picta* Emery

5'. Color of body and shape of head, not as above ..... *molesta* (Say)

KEY TO THE SPECIES OF *Tetramorium*

1. Hairs on head, thorax, petiole, and postpetiole short, erect, enlarged apically; head longitudinally rugulose with alveoli between the rugulae; length 1.75-2.25 mm. ..... *simillimum* F. Smith

1'. Characters not as described above ..... *guineense* (F.)

KEY TO THE *Dolichoderinae*

1. Epinotal declivity strongly concave; integument stiff and brittle; at least the epinotum more or less strongly sculptured (similar to Plate II, Fig. 16) ..... *Dolichoderus plagiatus pustulatus* Mayr var.

1'. Epinotal declivity not as above ..... 2

2(1'). Petiolar scale vestigal or absent ..... *Tapinoma sessile* (Say)

2'. Petiolar scale well-developed ..... 3

3(2'). Epinotum with a conical elevation (similar to Plate II, Fig. 17) .... *Dorymyrmex pyramicus flavus* McCook

3'. Epinotum rounded, without a conical elevation ..... *Iridomyrmex* Mayr

KEY TO THE SPECIES OF *Iridomyrmex*

1. Head subrectangular; head and thorax brownish ..... *pruinosus* (Roger)

1'. Head not subrectangular; head, thorax, and gaster reddish brown ..... *humilis* Mayr

KEY TO THE FORMICINAE

1. Antennae 9-jointed (similar to Plate II, Fig. 18) ..... *Brachymyrmex depilis* Emery

1'. Antennae with more than 9 joints ..... 2

2(1'). Workers di- or polymorphic ..... *Camponotus* Mayr

2'. Workers not polymorphic though often of variable size ..... 3

3(2'). Clypeal fossa distinctly separated from the antennal fossa ..... 4

3'. Clypeal fossa confluent with the antennal fossa ..... *Formica* Linn.

4(3). Pronotum with stiff bristles ..... *Paratrechina* Emery

4'. Pronotum smooth or with fine hairs ..... *Prenolepis* Mayr

KEY TO THE SPECIES OF *Camponotus*

1. Head of the major worker truncated anteriorly; truncated surface circular; intermediate forms between the largest and smallest workers lacking or extremely rare (similar to Plate II, Fig. 21) ..... *(Colobopsis)* sp. A

1'. Head of the major worker not truncated anteriorly; truncated surface not circular; intermediates nearly always present ..... 2

2(1'). Anterior median clypeal margin with a distinct but narrow notch; whole body black (Plate II, Fig. 20) ..... *caryae nearcticus* Emery

2'. Anterior clypeal margin entire, or at most feebly and broadly excised or sinuate in the middle; whole body not black ..... 3

3(2'). Clypeus ecarinate, or with a very feeble or blunt carina ..... *castaneus* Latr.

3'. Clypeus carinate ..... 4

4(3'). Middle and hind tibiae without a row of graduated bristles on the flexor surface; thorax yellowish to reddish brown, gaster very dark brown or black (Pate II, Fig. 19) ..... *abdominalis floridanus* (Buckley)

4'. Middle and hind tibiae with such a row; coloring different than above.. 5

5(4'). Dorsal surface of the first to third gastric segments pale yellow, separated from the pale posterior border by a narrow dark brown band ..... *socius osceola* Wheeler

5'. Dorsal surface of only the first and second gastric segments yellow; yellow spot on the dorsal surface of the second segment interrupted in the middle ..... *socius* Roger

KEY TO THE SPECIES OF *Paratrechina*

1. Antennae and legs usually long, the scape extending more than one-half its length beyond the posterior border of the head; body slender; long, coarse, suberect or erect hairs normally absent on the scape; integument with a metallic luster (Plate II, Fig. 22) ..... *longicornis* (Latr.)

1'. Unlike the above in one or more respects; tibiae and scapes, especially the former, usually with coarse, suberect hairs (similar to Plate II, Fig. 23) ..... *(Nylanderia)* sp. A

KEY TO THE SPECIES OF *Prenolepis*

1. Body piceous black; mandibles, antennae, tibiae, and tarsi lighter ..... *imparis* (Say)

1'. Body brownish or reddish yellow; gaster and occipital region darker .... *imparis testacea* Emery

KEY TO THE SPECIES OF *Formica*

1. Erect hairs absent on gula and petiole ..... *pallidefulva* Latr. var.

1'. Erect hairs present on gula and petiole ..... 2

2(1'). Gaster distinctly infuscated, darker than head and thorax (close to Plate II, Fig. 24) ..... *pallidefulva schaufussi* Mayr var.

2'. Gaster scarcely darker than the head and thorax, its pubescence longer and denser ..... *pallidefulva schaufussi dolosa* Wheeler

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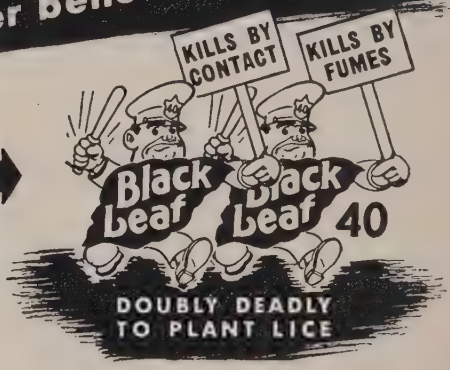


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